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ABSTRACT

The influence of financial aid on college student persistence was studied using causal modeling. The study population was 227 full-time freshmen, who enrolled in fall 1982 at a liberal arts college at a large commuter institution. All the students received financial aid. The model, which included background and academic variables, accounted for 35% of the variance in persistence. Persistence was measured by credits completed over a 2-year period. Background variables that were included in the analysis were income, high school rank, Preliminary Scholastic Aptitude Test scores, sex, major, and home proximity. College environment variables were the total aid awarded, merit grants awarded, the percentage of package grants, and grade point average. Based on path analysis, significant variables that showed the largest total effects on persistence were grade point average and high school rank. Neither the total aid awarded nor the percentage of package grants showed significant effect on persistence. A reduced model, which was applied to a second data set to validate the model, accounted for 24% of the variance in student persistence. (Author/SW)

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FINANCIAL AID AND STUDENT PERSISTENCE: AN APPLICATION OF CAUSAL MODELING

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Financial Aid and Student Persistence:

An Application of Causal Modeling

Abstract

This research uses path analysis to explore the relationships between a number of variables (including financial aid variables), which have been shown in both theory and prior research to be related to student persistence. The subjects were 227 full time freshman, who enrolled Fall Quarter 1982, in a liberal arts college at a large commuter institution of higher education, and who received financial aid. The model, which includes background and academic variables, accounted for 35% of the variance in persistence. Persistence was measured by credits completed over a two year period. Significant variables which showed the largest total effects on persistence were Grade Point Average and High School Rank. The financial aid variables in the model showed no significant effect on persistence in this study of students who received aid. A reduced model was applied to a second data set to validate the model. The reduced model accounted for 24% of the variance in student persistence, and the model was supported.

Financial Aid and Student Persistence: An Application of Causal Modeling

Longitudinal-process models of attrition/persistence began with Spady (1970) and Tinto (1975), and were developed further by Pascarella (1980) and Bean (1980). These models all had a theoretical base for understanding attrition/persistence as a longitudinal process involving a matrix of interrelated variables. These studies provided a basis for a better understanding of the process of student persistence in higher education, and provided helpful guidelines which improved persistence research. Since the development of Tinto's model (1975), most persistence studies have had a conceptual base, and numerous studies have sought to validate all or part of Tinto's model.

Prior to the development of theory based research, studies identified many variables thought to be related to student persistence (Pantages and Creedon, 1978; Ramist, 1981) and these variables are included in most persistence studies. Financial aid variables, however, are seldom included in the theoretical studies.

This study adds financial aid variables to the persistence model. Since over half of the students in higher education receive some kind of financial aid, aid awards have come to play an extremely important role in a student's opportunity to pursue higher education.

Financial aid was originally intended to reduce the costs of attendance for certain populations, and therefore increase student access. Later, financial aid began to be seen as a way of

providing students a choice of the institution they could attend. Research on financial aid is typically targeted to these two issues. There is, however, an additional question related to financial aid that has been studied less frequently: namely, how financial aid, or types of aid awarded, relate to persistence once the student has enrolled in a higher education institution.

Financial aid variables relate to both the quantity and the quality of the aid awarded. The total amount of aid awarded and the types or forms of aid awarded are both important to the study of financial aid. Financial aid is awarded to students in three forms: (1) grants which are non-repayable "gift" assistance, (2) loans, which must be repaid with some interest after a student discontinues attendance, (3) work-study, funds allocated through a federal and/or state program which pay a portion of the wages for part-time student employment. The student is awarded financial aid in a package which may include some or all of these forms of aid in varying dollar amounts.

Tinto's original theory (1975) and Bean's subsequent work (1980, 1981a, 1981b) were based on empirical data on attrition/persistence in residential institutions, and their models relied heavily on the academic and social integration of the student into the institution. Many validation studies of these models are still conducted in residential institutions (Pascarella, Terenzini, & Wolfle, 1986; Terenzini and Pascarella, 1984). Until recently very little research using models of student persistence has been done in non-residential or commuter institutions.

Recent studies have shown that institutional characteristics

(such as residential or commuter institution), may have important effects on the model of student persistence (Pascarella and Chapman, 1983), and that the model for students in commuter institutions may be somewhat different than that found in residential institutions (Pascarella, Duby, and Iverson, 1983). Pascarella and Chapman (1983) found that in commuter institutions, social integration in the model had no effect, direct or indirect, on persistence. A reconceptualization of Tinto's model, as done by Pascarella, Duby, and Iverson (1983), for study of commuter institutions seems appropriate.

The causal model used in this study was developed out of the more generalized persistence models but was adapted as a result of recent research on persistence in commuter institutions (Pascarella and Chapman, 1983; Pascarella, Duby, and Iverson, 1983). It is consistent with the models developed by Bean (1980) and Voorhees (1985) in that college environmental variables are posited to be important to persistence. This model differs from most of the previous models of persistence because it does not include social integration variables.

The model used in this study hypothesizes that persistence for the "typical" freshman at a large commuter institution is based on three sets of variables: background characteristics, financial aid awards, and grade point average(GPA). Although Tinto's original model and subsequent validation studies (Pascarella and Terenzini, 1977; Terenzini, Pascarella and Lorang, 1981) indicated that background characteristics do not have a direct effect on persistence, it was hypothesized that background variables would have important direct effects in this study in a

commuter institution.

The primary purposes of this study were: (a) to use causal modeling to study the role of financial aid on persistence; and (b) to develop and test a causal model, that places emphasis on academic variables, in a commuter institution.

METHOD

Design and Data

The general design of this study was longitudinal. Persistence, the dependent variable, was indicated by the number of credits completed during the total time period covered by the 1982-1983 academic year, the two summer sessions in 1983, and the 1983-1984 academic year.

Independent variables consisted of student's pre-matriculation background characteristics, financial aid variables, and cumulative college gpa.

The empirical basis for this study was a data base created specifically for this research project by the merging of three existing institutional data bases, each under the control of a different agency. The data elements came from three data bases of the university and the state:

1. The University Student Data Base
2. The Comprehensive Financial Aid Report for all applicants to the State Scholarship and Grant program. (CFAR tapes).
3. The University Financial Aid Office Year End Report.

The unique features of this data base are the inclusion of family financial information, and the actual dollar amount awarded to students in the various forms of financial aid.

Since the financial aid data were based on the actual awards

made for the first year of college, the study reflects the effect of financial aid awarded in the first year, on persistence through the first two years.

Study Population

The study population included 452 freshman who enrolled in Fall Quarter 1982 in the liberal arts college of a large, urban, doctoral granting, commuter institution in the midwest. This population was randomly divided to provide a study group and a validation group. The study group consisted of 227 students, and the validation group of 225 was used to cross-validate a reduced model.

The group of "typical" new freshman students who were initially enrolled as "full time" and who also received financial aid was selected for the study. Additional criteria were that the subjects be residents of the state in which the university is located, enrolled directly from high school, be between the ages of 16 and 20, and classified as "dependent" students (dependent on parental support as defined by financial aid guidelines). A homogeneous group was selected to increase the accuracy of the description of persistence for this "typical" new freshman group rather than to attempt to generalize to the whole freshman class.

Males constituted 42% of the subjects, and females 58%. Minority group members comprised 5.6% of the population. The mean PSAT verbal plus math score for students in the study was 96.8. This is very similar to the reported mean of 95.3 for the liberal arts college. The study population appears to be similar to the freshman class in the liberal arts college on these variables.

Statistical Analysis

This study employs multiple regression and path analysis methodologies. Path analysis, a type of causal modeling, was chosen as a methodology because of indications found in prior research that interrelationships among the variables relating to persistence are important to the understanding of the process. Path analysis allows the decomposition of effects into direct and indirect effects which helps to describe and understand the total system of linkages between the variables; it provides a rich interpretation of the underlying structure of the model.

Path analysis is a heuristic device which necessitates the specification of a causal model of "a priori" relationships among the variables. It is theory, not data, that builds the model. Theory specifies the ordering of the variables, and then the fit of the model to the data is tested through the use of the least squares multiple regression methodology. The objective is to compare the model to the data to see if the fit is close, thereby indicating whether the model should be retained. If the fit is not close then the model must be revised or a new model proposed. If the theory is found to be consistent with the data, it is understood to mean that the theory withstood the test: that it has not been disconfirmed (Pedhazur, 1983).

In path analysis several regressions may be necessary. At each stage, a variable taken as dependent is regressed on the variables on which it is assumed to depend. Each multiple regression equation provides a standardized coefficient or beta weight which is the net effect of an independent variable on a dependent variable when all other independent variables are taken

into account. These are the direct effects. The sign of the beta weight indicates whether the relationship between the two variables is positive or negative, and the magnitude of the beta weight indicates its rank order of importance or influence in the model.

Path analysis allows the simultaneous analysis of many variables, and from the decomposition of the effects of variables in the model into direct and indirect effects, a total causal effect can be obtained. The total causal effect is probably the best way of assessing the importance of a variable.

Listwise deletion was used for missing data in the regressions; students with missing information on any variable were excluded from the study. When hypothesis testing is done, consistency is important, and the use of listwise deletion means that the same cases are used to estimate all the coefficients.

Measurement of the Variables

The independent variables in the model are of two types: background variables which reflect the student's pre-matriculation characteristics, and college environment mediating variables.

Persistence, the dependent variable, is defined as the total number of credits the student completed during the time he or she attended the university, within the time-frame of this study (the 1982-1983 academic year, the two summer sessions in 1983, and the 1983-1984 academic year).

Although the student initially must have attended the liberal arts college in the university to have been included in this study, the credits completed subsequently may have been taken through any other college within the university. This variable

reflects persistence at the larger university and not just in the liberal arts college.

In this study a continuous variable, Credits Completed, was used as the measure of persistence. This criterion is different from that used in most persistence research. Many persistence studies have used a dichotomous variable as the persistence measure, for example scoring dropouts as 0 and persisters as 1, or have used semesters completed as their criterion. The use of a continuous variable in this study allows more precision of measurement than a dichotomous variable, and is more appropriate when multiple regression is to be used as a methodology.

The following are operational definitions of the variables in the persistence model:

Background Variables.

1. Adjusted Available Income (Adj Income). A broad index which is a net picture of the economic strength of the student's family. It is the result of a combination of income and assets, and takes into account family circumstances such as number of children and age of older parent.

2. High School Rank (HSR). The percentile rank of the student's grade point average in relation to his or her high school classmates. Rank was calculated at the end of the student's junior year in high school.

3. Preliminary Scholastic Aptitude Test (PSAT). This test is an indicator of a student's ability level. The Verbal and Mathematics scores were added together to form a single index. The test was administered in the student's junior year in high school.

4. Sex. Sex of the student coded (0) male, (1) female.

5. Major Chosen. Whether the student had chosen a major at the time of his or her application to attend the liberal arts college. Dummy coded: (0) Undecided, (1) Major chosen.

6. Home Proximity. Whether the county which the student listed as his or her home is in the seven county metropolitan area surrounding the university, or in some other outstate county. Dummy coded: (0) Metropolitan, (1) Outstate.

College Environment Variables.

1. Total Aid Awarded (Total Aid). The total dollar amount of all types of financial aid awarded to the student for the freshman year. Rounded to even dollar.

2. Merit Grants Awarded (Merit Grants). Indicates whether the student received any merit grants for the freshman year. Dummy coded: (0) No, (1) Yes.

3. Percentage of Package Grants (% Pkg Grants). The percentage of the student's total financial aid package that was awarded in the form of grants for the freshman year. Non-repayable "gift assistance".

4. Grade Point Average (GPA). The cumulative grade point average as of the last quarter of the student's attendance.

Dependent Variable.

1. Credits Completed. The number of credits a student has completed in any college within the university. A measure of the student's continued persistence to complete credits; of his continued effort to benefit from attendance at the university.

The model for this study was originally designed to include variables relating to several types of aid awarded. After the

data were examined, the work-study variable had to be dropped from the model because only 17 of the 227 students in the study group (8%) were awarded work-study aid at this institution. Further examination of the data also showed that of the 227 students in the study group, 207 (91%) had been awarded financial aid in the form of grants, and 135 (60%) had been awarded aid in the form of loans. Because of the high multicolinearity between grants and loans, a variable relating to financial aid in the form of loans was also dropped from the model.

RESULTS

Descriptive statistics from the independent and dependent variables in the model are available in Table 1. Information summarized includes the range, mean, and standard deviation of all the variables.

TABLE 1. DESCRIPTIVE STATISTICS FROM INDEPENDENT AND DEPENDENT VARIABLES (N=227)

VARIABLES	RANGE		MEAN	SD
	LOW	HIGH		
ADJUSTED INCOME	-13340	124966	9997.34	14386.87
HIGH SCHOOL RANK	22	99	81.67	15.25
PSAT	56	136	96.82	15.74
SEX	0	1	.58	.49
MAJOR CHOSEN	0	1	.78	.42
HOME PROXIMITY	0	1	.26	.44
TOTAL AID	135	7553	2306.23	1575.62
MERIT GRANTS	0	1	.23	.42
% PKG GRANTS	.00	1.00	.68	.34
GRADE POINT AVERAGE	1.00	4.00	2.75	.57
CREDITS COMPLETED	4	114	68.05	22.72

Table 2 provides the correlation coefficients among the variables in the model. An examination of the intercorrelations indicates that the highest bivariate correlation is .54, and therefore multicolinearity among the variables in the model is not a problem.

TABLE 2. CORRELATION COEFFICIENTS AMONG VARIABLES IN THE MODEL OF STUDENT PERSISTENCE (N=227)

VARIABLES	ADJ INCOME	HSR	PSAT	SEX	MAJOR CHOSEN	HOME PROX.	TOTAL AID	MERIT GRANTS	% PKG GRANTS	GPA	CREDITS COMP.
ADJUSTED INCOME	----										
HIGH SCHOOL RANK	0.20***	----									
PSAT	0.23***	0.35***	----								
SEX	0.06	0.14*	-0.05	----							
MAJOR CHOSEN	0.04	0.13*	0.02	0.06	----						
HOME PROXIMITY	0.10*	<0.00	0.11	0.03	-0.02	----					
TOTAL AID	-0.25***	-0.09*	-0.12**	0.03	-0.08	0.20***	----				
MERIT GRANTS	0.04	0.29***	0.27***	0.02*	0.07	0.02*	-0.09***	----			
% PKG GRANTS	-0.13***	0.09*	0.15***	-0.13*	0.02	-0.14*	-0.39***	0.34***	----		
GRADE POINT AVERAGE	0.22***	0.41***	0.30***	0.02	0.05	0.02	-0.01	0.24***	-0.01	----	
CREDITS COMPLETED	0.21	0.34	0.23	0.11	-0.04	<0.00	0.04	0.20	-0.10	0.54	----

NOTE. * p <.05. ** p <.01. *** p <.001.

Since some persistence studies have found an interaction effect based on the sex of the student, a test for interaction effects was done to determine if separate models for males and females were necessary. A significance test of the F-ratio was done between a model with direct effects and a model which in addition had all the interaction effects of sex. The increase in R square between the models was not significant. No interaction effect was found and therefore only one model is studied.

The use of path analysis required the regression of the dependent variable, Credits Completed, on all variables that precede it in the causal model. Then, GPA was regressed on the six background variables and the three financial aid variables. Finally, the financial aid variables were regressed on the six

background variables.

Table 3 presents the beta weights, or standardized regression coefficients for each variable (also called path coefficients). The $p \leq .05$ level of significance was used.

TABLE 3. STANDARDIZED REGRESSION COEFFICIENTS USED TO INTERPRET CAUSAL MODEL OF STUDENT PERSISTENCE

INDEPENDENT VARIABLES	DEPENDENT VARIABLE				
	TOTAL AID	MERIT GRANTS	% PKG GRANTS	GPA	CRED. COMP.
ADJUSTED INCOME	-0.26***	-0.06*	-0.16*	0.08***	0.09*
HIGH SCHOOL RANK	-0.01	0.23***	0.08*	0.23***	0.14*
PSAT	-0.08	0.20*	0.17*	0.39***	-0.08
SEX	0.04	-0.01	-0.12	-0.01	0.06
MAJOR CHOSEN	-0.06***	0.03	0.02	0.00	-0.09
HOME PROXIMITY	0.23***	0.00	-0.14*	-0.05	-0.04
TOTAL AID				0.05*	0.05
MERIT GRANTS				0.13*	0.09
% PKG GRANTS				-0.11	-0.09
GRADE POINT AVERAGE					0.49***
R SQUARE	0.13	0.12	0.09	0.34	0.35

NOTE. * $p < .05$. ** $p < .01$. *** $p < .001$.

Standardized regression coefficients should be used when the independent variables are measured in different units, and when the main interest is in making comparisons of the coefficients across the variables within the same model and population. In this paper, the value shown in parenthesis after a variable name is the beta weight or standardized regression coefficient.

Two variables were statistically significant in explaining persistence. These were GPA (.49) and High School Rank (.14). GPA was found to have the largest statistically significant relationship of all the variables that were regressed on

persistence. Three variables were also statistically significant in explaining GPA. These were PSAT (.39), High School Rank (.23), and Merit Grants (.13).

In addition, a number of statistically significant relationships were found when each of the three financial aid variables were regressed on the six background characteristics. Two variables statistically significant in explaining Total Aid were Adjusted Income (-.26) and Home Proximity (.23). The two variables statistically significant in explaining Merit Grants were High School Rank (.23) and PSAT (.20). There were three statistically significant variables that explain Percentage of Package Grants: Adjusted Income (-.16), PSAT (.17), and Home Proximity (-.14).

Sex and Major Chosen showed no significant direct effect on any of the financial aid variables, GPA, or Credits Completed.

Decomposition of effects

The direct effects are the path coefficients or betas associated with each variable. The indirect effects represent the influences of each causal variable on the dependent variable that are mediated through other variables in the model. The total effect of a variable is the sum of its direct and indirect effects.

The regression coefficients or beta weights that are statistically significant are represented by paths in the Reduced Path Model in Figure 1.

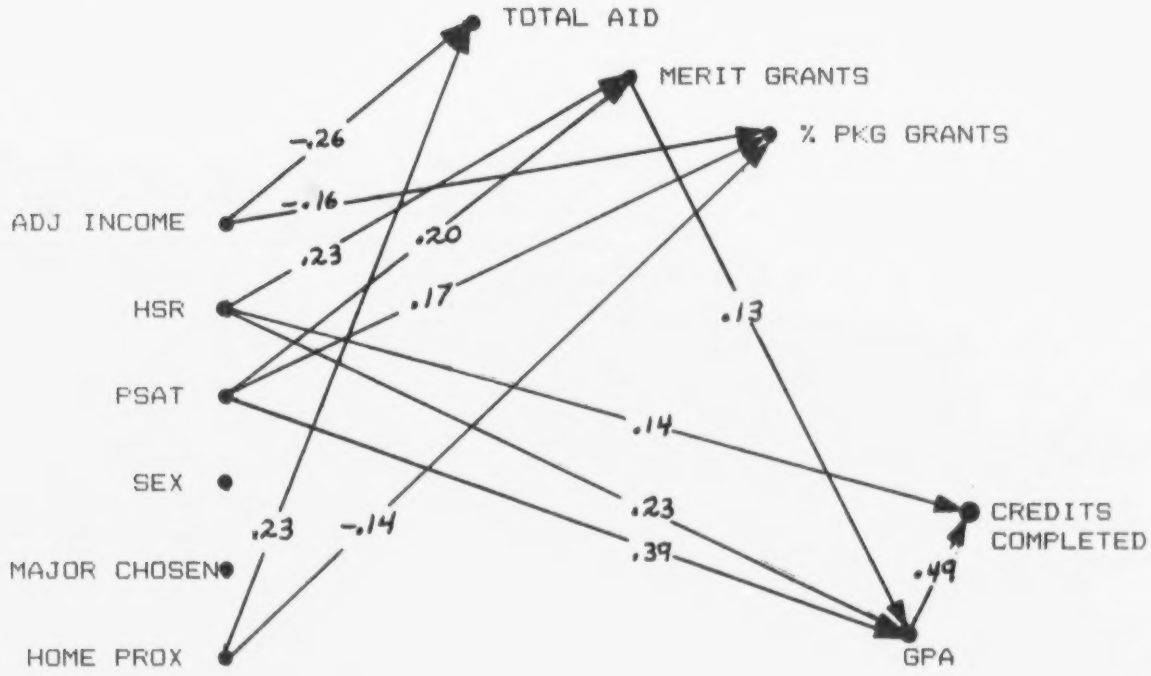

Figure 1. Reduced Path Model

Significant paths with indirect effects were identified through Duncan's rules for tracing paths (1966). The indirect effects are the product of coefficients between any mediating variable and that mediating variable and the dependent variable.

Five indirect effects for Credits Completed were calculated. All of the indirect effects were mediated through GPA. The largest indirect effect of .20 was found between PSAT and Credits Completed. Most of that indirect effect (.19) was mediated only by GPA, while a small additional indirect effect (.01) was mediated through both Merit Grants and Grade Point Average. It is interesting that even though PSAT does not show significant direct effects on Credits Completed, that there is a large indirect effect mediated through other variables.

The next largest indirect effect was between High School Rank and Credits Completed (.13). The largest part (.11) is mediated through GPA, with a smaller amount (.02) through Merit Grants.

The other indirect effect was between Merit Grants and Credits Completed (.06) and was entirely mediated through GPA.

Total Effect

In this study, GPA with a direct effect of .49 was the most important variable in explaining persistence. This effect was expected and has been frequently theorized by Spady (1970) and others.

High School Rank was also found to have an important total effect on persistence (.27). The direct effect on persistence was .14, but the indirect effect of .13, was equally important. This is consistent with the majority of research in the area of student persistence. It is not surprising that Merit Grants with a total effect of .15 is also significant in addition to High School Rank, since High School Rank is often used as a basis for making the merit grant award.

The most important total effects on GPA were PSAT (.42), High School Rank (.26), and Merit Grants (.13). These effects were primarily direct effects of each variable on Grade Point Average. The indirect effects of High School Rank and PSAT were each less than .03.

The effects of Home Proximity were negligible in this study. The variable was included because some previous studies have found distance from home to have an effect on persistence. Since this study collapsed distance from home into metropolitan and outstate categories, it is possible that if actual miles from home had been

used, that some effect may have been found. It should be noted however, that most of the studies that reported distance as having an effect, were conducted in residential institutions.

Variance

The R square is an estimate of the variance accounted for in the model. The R square for the full model was .35 and indicates that 35% of the variance in credits completed was accounted for by the ten variables in the model.

The R square for GPA was .34. The nine variables in the full model accounted for 34% of the variance in GPA.

Reduced Path Model

The original causal model was trimmed to make the reduced path model as was shown in Figure 1. The reduced model includes only those 12 paths found significant at the .05 level in the original full model.

When a reduced model is re-analyzed on the same group of students, the results capitalize on the particular uniqueness of that group, and it begins to look like exploratory work instead of the confirmatory purpose for which causal modeling was intended. A more conservative approach is to test the reduced model on a new data set.

In this study a cross-validation of the model was done by applying the reduced path model to a second set of data. The reduced model was tested on the data from the randomly determined second half of the total population. This validation group was composed of 225 students. The R square for the reduced model on the validition group was .24. This is to be compared with the earlier finding of an R square of .35 that was obtained for the

full model on the study group.

Confidence intervals using unstandardized coefficients were computed for the variables in the full model to compare it to the reduced validity model. When parameters in one population are considered in comparison to another population, then unstandardized regression coefficients should be used.

The unstandardized regression coefficients obtained from the reduced model are within the 95% confidence intervals derived from the unstandardized coefficients and standard errors of the full model. This cross-validation indicates that the model is supported.

SUMMARY AND DISCUSSION

The model tested proved useful in the study of persistence at a large, urban, commuter institution. The determinants in the model accounted for 35% of the variance in persistence defined as Credits Completed. This result compares favorably with the results of other attrition studies (Bean, 1980; Pascarella and Chapman, 1983). The result also compares favorably with the results found by Pascarella, Duby, and Iverson (1983) in their study of persistence in commuter institutions where they reported models accounting for 19% and 28% of the variance in persistence in commuter institutions. It should be noted, however, that most studies do not use Credits Completed, as the measure of persistence.

The important findings of this study relate to the financial aid variables. Since the population used in this research was made up only of those students who were awarded financial aid, the question was not whether financial aid has effects on persistence,

but rather does the amount or type of aid have an effect on persistence.

None of the financial aid variables used in this study were significant in relation to the persistence measure of Credits Completed. The only significant effect of a financial aid variable was that of Merit Aid on Grade Point Average and that would be expected. Neither the Total Aid Awarded or the Percent of Package Grants, has a significant effect on persistence in the model.

It is useful to remember that financial aid was originally intended to increase access and choice in higher education; its original intent was not specifically to affect persistence, although occasionally aid is awarded as though it does. According to the results of this study, awarding larger amounts or specific types of financial aid to students does not effect persistence. Findings of studies such as this could be useful to educational administrators who make decisions relating to amounts and types of aid to be awarded. They could use empirical evidence as a basis for their decisions.

Another finding of this research is that background pre-matriculation characteristics are important when persistence is studied in a commuter setting. Background variables have direct and indirect effects on persistence. This is contrary to the findings of previous studies done in residential settings (Pascarella and Terenzini,1979; Terenzini, Pascarella, and Lorang, 1981) where it has been found that background variables do not directly influence persistence, but rather are mediated by other variables in the college environment.

Although it is a well known fact, this study again points out the importance of the pre-matriculation variable of High School Rank. Looking at it from a cost-benefit point of view, High School Rank with a total causal effect of .27 on credits completed (of which .13 is an indirect effect), is a very easy, inexpensive, and routinely collected piece of information about a student, and a good predictor of persistence in a commuter institution.

High School Rank may be a more useful measure of academic performance in high school than secondary school grades. At least one study (Pascarella, Duby, Iverson, 1983) found secondary school grades to have a significant negative influence on persistence (interpreted as possibly due to collinearity among predictors). In this study, High School Rank was shown to be a significant variable.

The decomposition of effects revealed that even though PSAT may show a small or even negative effect on persistence, that there may be a large indirect effect, and therefore test scores should be included in persistence models.

In addition, since there was a significant direct effect of High School Rank on Credits Completed, but a significant indirect effect from PSAT, it may also be more useful to use PSAT and HSR as separate variables in persistence models than to combine them into a single index.

Even though the persistence model used in this study included only background, financial aid, and academic variables, it accounted for as much of the variance in persistence in this commuter institution as is usually found in studies which also include social factors. It demonstrates that in a commuter

institution, a model may explain 35% or more of the variation in persistence without the inclusion of the social integration variables postulated in Tinto's persistence model.

This research suggests that persistence studies could be useful as policy studies for educational administrators who make decisions about the disbursement of financial aid money. This study further suggests the importance of academic variables when persistence is studied in a commuter institution.

Tinto's model continues to be useful when it is applied to a commuter institution, however, the operationalization of its concepts may need to be revised. Further work on the validation of Tinto's model in commuter institutions may result in a redefinition of the model itself, or in changes in the relative importance of its various elements.

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